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Rates of HIV and Hepatitis Infections in Clients Entering Heroin-Assisted Treatment between 2003 and 2013 and Risk Factors for Hepatitis C Infection

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Key Words
HIV · Hepatitis · Heroin-assisted treatment · Heroin users · Risk factors

Abstract
Background/Aims: We report on the rates of hepatitis A virus (HAV), hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV) in 1,313 clients entering heroin-assisted treatment (HAT) in Switzerland from 2003 to 2013. We identify predictors of HCV infection. ***Methods:*** Data were collected using questionnaires within 2 weeks of clients' first entry into HAT. Prevalence of HAV, HBV, HCV and HIV was calculated using laboratory test results collected at entry or using reports of older test results. Predictors of HCV status were identified through multiple logistic regression analysis. ***Results:*** Results show stable rates of HIV-positive clients and decreasing proportions of HAV- and HBV-infected clients. In 2013, there were 12% (n = 8) HIV-, 20% (n = 12) HAV-, 20% (n = 12) HBV- and 52% HCV- (n = 34) positive clients. Vaccination against HAV and HBV had become more frequent. Predictors of positive HCV status included older age, female gender, earlier year of entry, having spent 1 month or more in detention or prison, use of injected heroin and more years of intravenous use. ***Conclusion:*** Our results highlight the fact that efforts to prevent and test for infections and to promote vaccination against HAV and HBV in heroin users need to be continued.

Introduction

The history of heroin-assisted treatment (HAT) in Switzerland began more than 20 years ago. In 1994, HAT started in the context of a scientific project to assess the feasibility, impact on patients' health and social functioning, safety, and societal impact (e.g. delinquency levels or incidence of starting heroin use) of heroin substitution for severely dependent heroin users. After years of political discussions and uncertainty about the future of HAT, in 2008, the treatment received a definite legal basis through its integration into the Federal Law on Narcotics [1]. The treatment is available for opioid users older than

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18 years, who have been opioid dependent for at least 2 years, who have failed at least 2 treatment attempts for their opiate addiction, and who suffer medical, psychological or social deficits related to their drug use. Specialised treatment centres, of which there were 23 in 2003 and 22 in 2013 (including 2 prisons), hold a permit to provide HAT.

Behaviour associated with heroin provision and consumption place users at increased risk of contracting infections, including blood borne human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV), and food or water-borne hepatitis A virus (HAV). These risks mainly arise when intravenous drug users share needles or drug preparation equipment or have unprotected sexual contacts, together with the structural conditions associated with inadequate hygiene, such as living in unstable housing and lacking or rejecting access to healthcare for fear of arrest or discrimination [2].

In the general Swiss population, HAV incidence between 2005 and 2013 decreased from 1.9 to 0.7 and HBV incidence from 1.2 to 0.8 per 100,000 inhabitants [3]. Chronic hepatitis B prevalence (HBs antigen positivity) in Switzerland is estimated to be 0.3%. The prevalence of HCV antibody is currently estimated to be 0.7–1.0% of the general population; incidence decreased between 2005 and 2013 from 1.0 to 0.6 per 100,000 inhabitants. Prevalence of HIV in Switzerland is estimated to be 0.3% [4]. The last study reporting hepatitis and HIV prevalence in HAT clients in Switzerland used data from 2000 to 2002 [5]. That study reported 41.2% HAV-, 53.3% HBV-, 78.3% HCV- and 12.6% HIV-positive patients, which represented a reduction in HAV and HBV, but not in HCV and HIV infections, compared to two earlier HAT cohorts (1994–1996 and 1998). The authors concluded that HCV prevention, in particular, needed to be improved and more consistent vaccination against HBV and HAV was required in intravenous drug users.

The Swiss Federal Office for Public Health regards injecting drug users (IDUs) as a target group for combined vaccination against HAV and HBV [6]. There is currently no vaccine for HCV. In 70–85% of infected individuals, the disease becomes chronic and up to 1 quarter of untreated patients suffer liver failure or liver cancer. Interferon-based treatments allow recovery in 70–80% of patients. These treatments, however, are unpopular, due to their high intensity and side effects. New interferon-free treatments for HCV (Sofosbuvir plus Ribavirin for 24 weeks in genotype 3) may be more tolerable for patients; however, with costs of up to 120,000 Swiss Francs, these treatments are highly expensive [7]. Thus, prevention of HCV continues to be the most important factor in tackling the disease. To optimise prevention, risk factors for HCV seroconversion need to be identified. According to the literature, factors repeatedly associated with positive HCV or HCV antibody status in drug users included longer duration of intravenous drug use [8–11], female gender [12, 13], older age [8, 14], foreign ethnicity [9, 11] and history of imprisonment [9, 11, 14]. These studies used data collected until 2007 and, except for one study [10], they investigated intravenous drug users, as opposed to users of other routes of administration. From a preventive point of view, it would be of interest to look at more recent data and to investigate HCV risk in users with other routes of drug administration.

This study aims at reporting the development of HIV and hepatitis prevalence in HAT clients who were registered for treatment between 2003 and 2013. Therefore, this study is a continuation of the study of Gerlich et al. [5] who used corresponding data from 1994 to 2002. Furthermore, as HCV still appears to be the most widespread infection in drug users, together with the absence of vaccination against HCV and its high chronicity and hazardous effects on the liver, the study aims at identifying sociodemographic and drug use characteristics that predict HCV status in this sample of severely heroin-dependent individuals. Identifying these factors will help arrive at conclusions as to where the focus of HCV prevention should lie.

Methods

Data Collection

Data were collected in the context of the Swiss monitoring system of HAT established in 2000 [15]. Within this monitoring system, entry questionnaires are collected in all Swiss HAT treatment centres within 2 weeks of entry into HAT. Data are collected by caregivers, usually physicians or social workers, in the form of an interview with the client and are subsequently submitted to the Swiss Research Institute for Public Health and Addiction. The entry questionnaire underwent 2 revisions at the end of 2004 and 2012. For this study, full sociodemographic data were available for clients entering from 2005. For clients entering in 2003 and 2004, information is available on date of entry, treatment centre, age, gender, route of prescribed heroin administration, and HIV and hepatitis status.

Measures

HIV and Hepatitis Status

For HIV and HAV, the date of the latest test and its result ('negative' or 'positive') were assessed. For HBV and HCV, the results of tests conducted at entry were assessed as follows: for HBV, response options included 'anti-HBc positive', 'anti-HBc negative',

'anti-HBs positive', 'anti-HBs negative' and 'not tested' and for HCV, 'anti-HCV positive', 'anti-HCV negative', 'HCV-PCR positive', 'HCV-PCR negative' and 'not tested'.

Furthermore, information about vaccination against HAV and HBV was assessed using the question 'Has a decision been made at entry to vaccinate against HAV/HBV?'. Response options were 'Yes', 'No, client is already vaccinated', 'No, vaccination not indicated as client is seropositive', 'No, client rejects vaccination' and 'No, due to another medical contraindication'.

Predictors of HCV Status

Based on literature and clinical judgment, we considered the following variables as potential predictors of HCV status: gender, age at entry, nationality (Swiss vs. foreign), highest completed education (no or partly completed compulsory education, compulsory education, vocational education or apprenticeship or general education, higher vocational education or university, other), marital status (unmarried, married, separated or divorced or widowed), children (yes, no), housing in the 30 days prior to entry (stable, i.e. own or rented flat or house; unstable, i.e. hopping, shelter, hotel, homeless; institution, i.e. prison, hospital, therapeutic institution), main source of income in the 30 days prior to entry (employment, pension, social welfare, partner or family or friends, drug dealing or illegal activities or prostitution, other), judicial decision as basis of HAT (yes, no), time spent in detention or prison (<1, ≥1 month), 30-day point prevalence of heroin use prior to entry (0, 1–10, 11–20, 21–30 days), predominant form of heroin use (oral including smoke, nasal, injected, injected plus another form, not injected but several other forms), years of intravenous use, age at first heroin use and years of regular use (defined as using heroin at least 3 times per week or on 2 consecutive days or more per week). Furthermore, we included a variable called 'entry year group', which split the cases into entries during 2005–2008 and entries during 2009–2013. This split was based on a national HCV campaign starting in June 2008 and lasting several years that aimed at enabling drug treatment centres to conduct their own campaigns by providing them with guidelines for giving advice, as well as supplying them with the necessary materials (flyers, films, hygiene articles, labelled syringes). This campaign was supported by the Swiss Federal Office of Public Health [16].

Statistical Methods

Missing Case Analysis

Missing case analyses were performed for clients entering HAT between 2005 and 2013. To examine differences between clients with and without a completed entry questionnaire, we conducted χ^2 tests for gender, treatment centre and year of entry, and t tests for age at entry. To examine differences between clients with and without information on HAV, HBV, HCV and HIV status, we conducted χ^2 tests for gender, treatment centre, year of entry, nationality (Swiss vs. foreign), and t tests for age at entry and 30-day point prevalence of heroin use before entry.

Calculation of Prevalence of HIV and Hepatitis

For HIV prevalence, the result of the latest test was used. For HAV, clients were categorised as 'negative susceptible' if test results were negative and/or the question on vaccination status did not indicate vaccination or seropositivity. If the response option 'No, client is already vaccinated' was crossed, the client was categorised as 'vaccinated'. If the response option 'No, vaccination not indicated as client is seropositive' was crossed, the client was categorised as 'gone through'. Clients with a positive test result and missing information on vaccination were categorised as 'positive unknown'. We used old test results to assign an HAV status to clients whose test results at entry or information about vaccination were not available.

With HBV, clients were categorised as 'negative susceptible' if anti-HBc or an old test result had been negative and no vaccination had taken place. If both anti-HBc and anti-HBs were positive, or if an old result had been positive and no test results at entry were available, clients were labelled as 'gone through'. Clients were classified as 'vaccinated' if the response option 'No, client is already vaccinated' was crossed. If anti-HBc were positive and no anti-HBs results were reported, or if test results at entry were missing but 'vaccination not indicated as client is seropositive' was crossed, the client was classified as 'seropositive'.

With HCV, if a negative anti-HCV result was available, the clients were classified as 'negative'. If anti-HCV were positive but HCV-PCR were negative, the client was categorised as 'gone through'. If anti-HCV and HCV-PCR were positive, the client was classified as 'confirmed chronic'. If anti-HCV were positive but no HCV-PCR result was reported, the client was assigned the status 'seropositive'. If an old, positive anti-HCV test result, but no newer result was available, the status 'old positive result' was assigned. Although for HCV chronic disease is more probable than acute disease, we did not want to make any assumptions, as there is still a ca. 20% likelihood that the infection does not become chronic [16].

To illustrate the source of decisive information on HIV or hepatitis status, we created a variable with the categories 'old test result', 'new test result', and additionally for HAV and HBV, 'vaccination status question'. Furthermore, for old test results, we calculated the interval (in years) between the test and entry into HAT.

Predictor Analysis

Prior to predictor analysis, we imputed missing data on predictor variables through multiple imputation using the multiple imputation procedure in SPSS 22.0. Based on the assumption that data were missing at random, all available sociodemographic and heroin use variables (n = 18) were used as predictors of imputed values. We imputed 15 datasets. Our reported results are based on the combined results from these datasets. The dependent variable 'HCV status' was dichotomised into 'negative' or 'ever positive', the latter subsuming the categories 'gone through', 'seropositive', 'confirmed chronic' and 'old positive result'. Thus, the dependent variable 'HCV status' refers to HCV antibody tests regardless of any HCV-PCR tests.

We identified predictors of HCV status using logistic regression analysis. To choose predictors for the initial model, we applied a mix of purposeful selection and selection based on statistical significance ($p \leq 0.25$) [17]. After testing the predictors by univariate analysis, we fitted the full model and excluded predictors with $p > 0.05$ stepwise, examining changes in beta coefficients of the remaining variables to detect potential multi-collinearity. In the next step, we added each previously excluded predictor again to examine its significance in the presence of the retained variables. We assessed the goodness of fit of the final main effects model in terms of variance explained (Nagelkerke's R^2).

Results

Study Population

The sample consisted of 1,518 heroin users who entered HAT for the first time between January 6, 2003 and November 19, 2013. Of these, only 13.6% (n = 205) provided a minimum of information as required by the administrative entry procedure, instead of a fully completed entry questionnaire. There was no relationship between gender and form of prescribed heroin use and provision of a completed entry questionnaire ($p > 0.05$). Nor was there a difference in age at entry between clients who provided a questionnaire and those who did not ($p > 0.05$). There was, however, a significant association between year of entry ($p < 0.01$) as well as treatment centre ($p < 0.01$) and providing a completed entry questionnaire. Rates of questionnaire completion varied between a minimum of 69.6% (n = 94) of all clients entering in 2007 and a maximum of 99.2% (n = 130) of all clients entering in 2010 (mean 88.8%, SD 8.4%). With respect to treatment centres, questionnaire completion varied between 53.8% (n = 7) of all clients entering one treatment centre between 2003 and 2013 and 97.1% (n = 33 and n = 34, respectively) of all clients entering another treatment centre (mean 88.0%, SD 10.8%).

Entry data were available for 1,313 clients (i.e. for 303 entries from 2003 to 2004: gender, age, form of prescribed heroin use and HIV/hepatitis status; for 1,010 entries from 2005 to 2013: all variables). Clients had a mean age of 35.4 (SD 7.8, minimum = 18, maximum = 60) and 21.7% (n = 285) were female. As comparison, between 2000 and 2002, clients had a mean age of 33.7 and there were 17.6% women [5]. With respect to the form of prescribed heroin use, 53.1% (n = 697) of clients were prescribed intravenous heroin, 28.2% (n = 370) oral heroin, 3.1% (n = 41) intramuscular heroin, 4.3% (n = 57) intravenous and oral, 4.6% (n = 60) intravenous and intramuscular, 0.2% (n = 3) oral and intramuscular heroin, and 0.8% (n = 11) all 3 forms of heroin.

There were 83.9% (n = 834) Swiss nationals. With respect to the highest level of education, 8.1% (n = 81) had no or partly completed compulsory education, 29.7% (n = 296) had completed compulsory education (9 years of schooling), 56.0% (n = 557) had completed vocational education, apprenticeship or high school and 6.1% (n = 61) had completed higher vocational education or university. Almost three quarters of clients were unmarried (73.1%, n = 735), 8.5% (n = 86) were married and 18.4% (n = 185) were separated, divorced or widowed. Nearly three out of 10 clients had their own or adopted children (28.7%, n = 287). Few clients were in HAT on the basis of a judicial decision (5.6%, n = 55); however, 61.9% (n = 538) had spent 1 month or longer in detention or prison. In the 30 days prior to entry, 69.3% (n = 695) had lived in stable housing, 12.8% (n = 128) in unstable housing and 17.9% (n = 180) in an institution. Social welfare was the main source of income of 51.8% (n = 512) of clients, while 22.3% (n = 220) survived on their pension or disability insurance, 12.4% (n = 123) on employment, between 2.2 and 2.9% (n = 22–29) on unemployment insurance, on relatives or friends, on drug dealing or prostitution, or on various other sources of income.

In the 30 days prior to entry, 17.8% (n = 174) had not used any illegal heroin, 18.4% (n = 180) had used illegal heroin on 1–10 days, 11.8% (n = 116) on 11–20 days and 52.0% (n = 510) on more than 20 days. Most clients combined injecting illegal heroin with another form of use (36.8%, n = 334), while 34.7% (n = 315) only injected, 7.3% (n = 66) used oral heroin (including smoking), 14.1% (n = 128) nasal heroin and 7.2% (n = 65) combined several other forms of use without injecting. On average, clients had used heroin for the first time when aged 19.0 (SD 5.4), which is in agreement with the findings of Gerlich et al. [5]. Clients had used heroin regularly for 13.4 years (SD 7.3; Gerlich et al. [5] 11.6 years) and had used intravenous heroin for 9.7 years (SD 8.2).

Prevalence of HIV and Hepatitis

Information on HIV status was available for 78.1% (n = 1,025), on HAV for 66.4% (n = 871), on HBV for 70.4% (n = 924) and on HCV for 71.3% (n = 936) of the 1,313 clients entering between 2003 and 2013 who provided a completed entry questionnaire.

For HIV, in 48.3% (n = 495) of clients the information about status originated from test results at entry, while for 51.7% (n = 530) of clients an old test result was available. Of the clients with old test results, 71.1% (n = 229) provided a result that was up to 2 years old. The decisive status information for HAV was provided by the old test result in 25.0% (n = 218), by the new test result in 26.5% (n = 231) and by the question on vaccination status in 48.5% (n = 422) of cases. Old HAV test results were no older than 2 years in 62.9% (n = 66) of cases. The decisive status information for HBV was provided by the old test result in 28.4% (n = 262), by the new test result in 30.2% (n = 279) and by the question on vaccination status for 41.5% (n = 383) of clients. In 60.2% (n = 106) of clients with an old test result, this result was no older than 2 years. The decisive status information for HCV was provided by the old test result in 53.3% (n = 499) and by

Table 1. Prevalence of HIV, HAV, HBV and HCV according to year of entry

HIV	2003–2004		2005–2007		2008–2010		2011–2013	
	n	%	n	%	n	%	n	%
Positive	23	10.7	31	11.4	20	7.3	22	8.4
HAV								
Vaccinated	38	21.3	64	26.8	75	31.5	73	33.8
Gone through	65	36.5	80	33.5	46	19.3	43	19.9
Seropositive	9	5.1	6	2.5	11	4.6	6	2.8
Ever positive (lifetime)	74	41.6	86	36.0	57	23.9	49	22.7
HBV								
Vaccinated	46	23.8	60	23.3	76	30.3	76	34.2
Gone through	63	32.6	81	31.4	46	18.3	29	13.1
Seropositive	21	10.9	18	7.0	19	7.6	11	5.0
Ever positive (lifetime)	84	39.6	99	38.4	65	25.9	40	18.1
HCV								
Gone through	3	1.4	12	4.9	11	4.5	9	3.8
Seropositive	41	19.8	47	19.1	39	15.8	33	14.0
Confirmed chronic	10	4.8	21	8.5	14	5.7	17	7.2
Old positive result	89	43.0	85	34.6	71	28.7	67	28.4
Ever positive (lifetime)	143	69.0	165	67.1	135	54.7	126	53.4

the new test result in 46.7% (n = 437) of clients. Old test results were no older than 2 years in 63.7% (n = 181) of clients.

There were no differences in gender and nationality (Swiss vs. non-Swiss) between clients with sufficient information on HIV and all hepatitis types and those without sufficient information (all $p > 0.05$). Similarly, there were no age differences ($p > 0.05$). However, there was an association between the predominant form of heroin use and the method of providing sufficient information on HIV, HAV and HCV (all $p < 0.05$). Clients with sufficient information more frequently injected heroin than using other forms of administration. For example, 74.4% (n = 503) of clients with sufficient information on HCV injected heroin, vs. 62.8% (n = 145) of clients with insufficient information. Furthermore, clients with a lower 30-day point prevalence of heroin use prior to entry were more likely to provide information on HIV and all hepatitis types than clients with a higher prevalence. For example, 49.0% (n = 353) of clients with sufficient information on HCV used heroin on more than 20 days, while this proportion was 60.6% (n = 154) in clients with insufficient information ($p < 0.01$).

The results on prevalence of HIV and HAV, HBV and HCV are presented in table 1 and figures 1–4. The prevalence of HIV-positive clients fluctuated around 10%, with the lowest percentage in 2008 (3.4%, n = 3) and the highest in 2006 (12.5%, n = 12). The proportion of HAV ever-positive clients (i.e. lifetime prevalence) decreased from 44.3% (n = 39) in 2003 to 18.7% (n = 14) in 2010. Since then, the proportion has seemed to fluctuate around 20%, apart from a deviation in 2011. The decrease in HAV lifetime prevalence coincides with an increasing number of vaccinated clients, from just over 20% to more than 30% in recent years. HBV lifetime prevalence was 48.9% (n = 45) in 2003 and then underwent an unsteady decrease, to arrive at 20.0% in 2012 and 2013 (n = 15 and n = 12, respectively). While in earlier years, one fifth to 1 quarter of clients were vaccinated against HBV, since 2010, at least one third of clients have been vaccinated. While HCV lifetime prevalence was 70.8% (n = 75) in 2003, this proportion decreased to 54.0% in 2008, but has since fluctuated around this level. On the basis of all positive new results, we calculated the lowest proportion of chronic courses of disease for 2010 (4.4%, n = 4) and the highest proportion for 2005 (9.4%, n = 9).

Predictors of HCV

Univariate Analysis

Based on univariate analysis, the following characteristics were positively associated with ever having been HCV positive: higher age at entry, being separated, divorced or widowed, drug dealing, illegal activities or prostitution as main source of income, number of months spent in detention or prison, nasal, injected and injected plus another form of predominant heroin use,

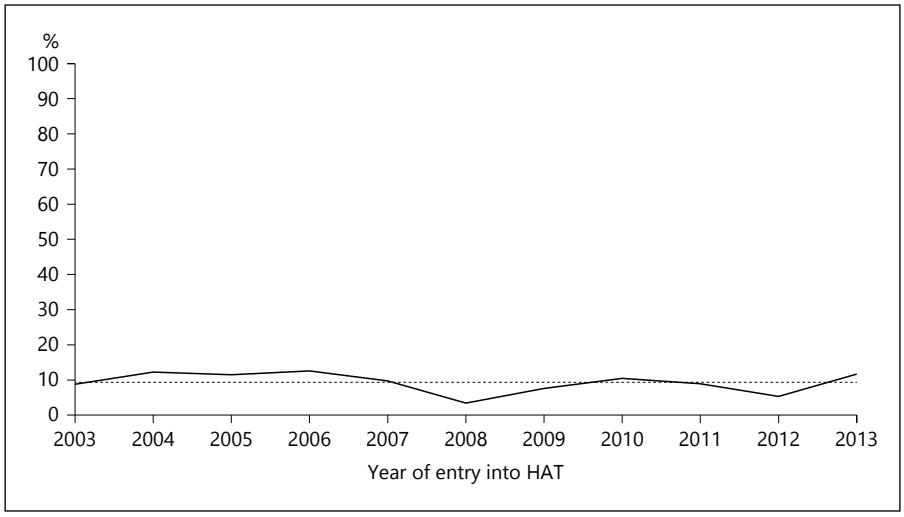

Fig. 1. Percentage of HIV-positive clients according to year of entry.

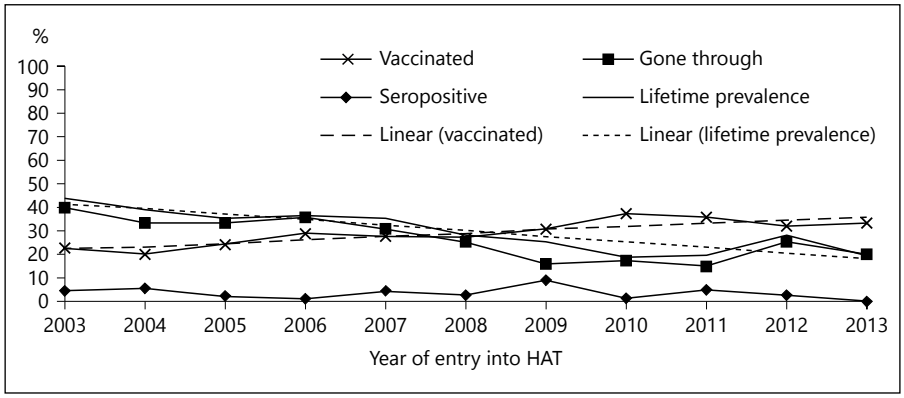

Fig. 2. HAV status according to year of entry.

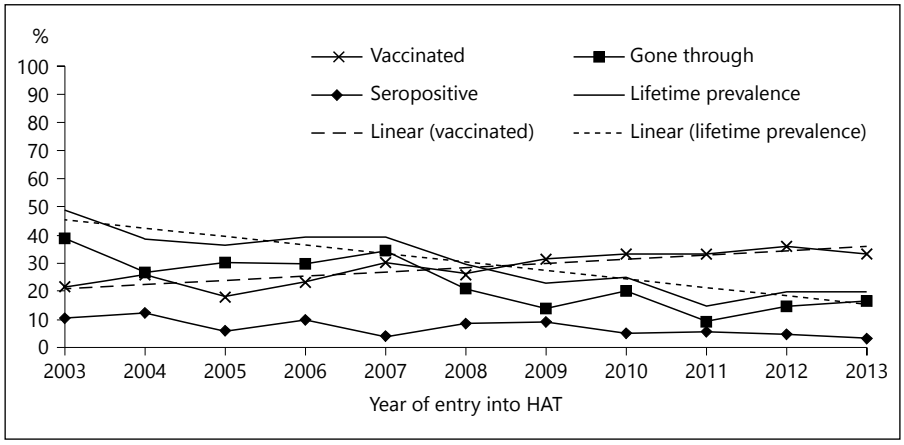

Fig. 3. HBV status according to year of entry.

number of years of regular use, years of intravenous drug use and having spent 1 month or more in detention or prison (table 2). Meanwhile, entry year group and age at first heroin use were negative predictors of positive HCV status.

Multivariate Model

According to Nagelkerke's R^2, the final model explained 22.5% of variance in HCV status. Multivariate predictors of HCV status included higher age at entry, female gender, entering between 2005 and 2008, having

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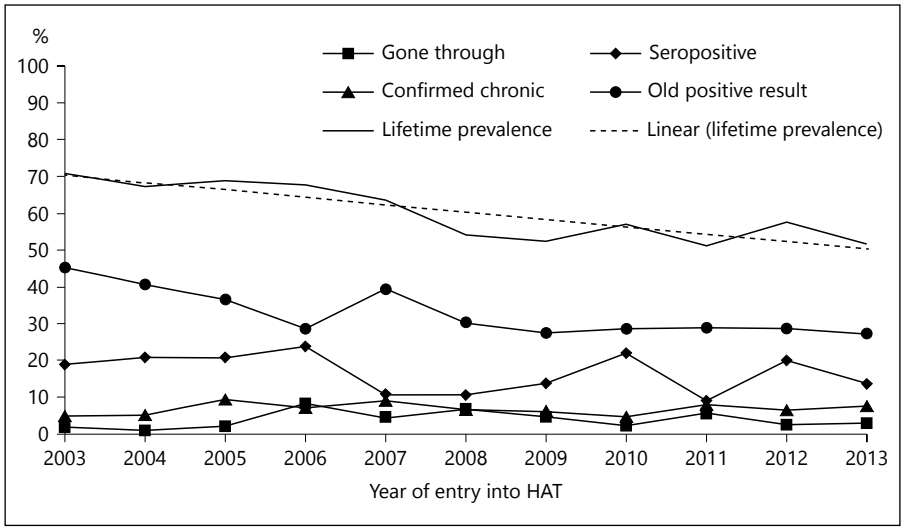

Fig. 4. HCV status according to year of entry.

spent 1 month or more in detention or prison, using injected heroin, more years of intravenous use and lower age at first heroin use (table 3).

Discussion

Our results show that decreasing proportions of HAV- and HBV-infected clients entered HAT in Switzerland between 2003 and 2013 (minus ca. 25% points). At the same time, vaccinations against HAV and HBV have become more prevalent (plus ca. 11% points). Our findings indicate a continuation in the decrease in HAV and HBV infections as reported by Gerlich et al. [5]. In addition, we observed a remarkable decrease in HCV-positive clients between 2003 and 2013 (minus 19.3% points). Thus, our overall results are highly encouraging in the context of the promotion of HAV and HBV vaccine and the prevention of HAV, HBV and HCV. HIV infections in new HAT entries, in contrast, have remained stable throughout our studied period.

Our observed prevalence of all infections, however, is still remarkably higher than their prevalence in the general Swiss population [3, 18] and in patients admitted to the emergency room of a Swiss university hospital (6.7% HBV and 2.7% HCV, respectively) [19]. These contrasts highlight the fact that efforts to test and prevent infection and to promote vaccination against HAV and HBV in heroin users need to be continued.

For the period of 2005–2008, the prevalence of HBV in our HAT sample was similar to that in IDUs in other European countries (Europe: 39%; Swiss HAT: 34%) [20]. According to our results, HCV remains the most frequent infection in HAT clients. A Spanish HAT study reported an even higher prevalence (94%) than that found in our study (69%) in participants recruited 2003–2004 [21]. The prevalence of HCV found in our sample between 2005 and 2009 (61%) however, is similar to the prevalence reported in Canadian HAT clients (63%) [22] and generally in IDUs in Europe (58%) [20]. We were not able to identify more recent international reports on the prevalence of any hepatitis type in HAT clients or more generally, in IDUs. Regarding HIV, the Spanish HAT study found a higher rate (40.3%) of affected clients recruited in 2003–2004. Prevalence reported in Canadian HAT clients (10%) recruited from 2005 to 2008 is in line with our prevalence. Our finding that HIV prevalence has remained stable is in line with IDU data from most countries in the European Union/European Economic Area in the period from 2008 to 2011 [23].

We found relative decreases of 54.5 and 40.2% in clients classified as having gone through HAV and HBV between the periods of 2003–2004 and 2011–2013. However, we cannot say whether some of the cases classified as 'HBV gone through' might have developed chronic infection, as the questionnaire did not assess eventual HBs antigens. In drug consumers, up to 40% of individuals with only HBc antibody detectable (HBc alone) might have low levels of circulating HBV DNA (http://www.viralhepatitis.ch/de/node/691 [in German]). Chronic courses can affect up to 85% of HCV-positive individuals, so that the rate of chronic courses that we found (maximally 37.5% in 2007) is very low. As many HCV-PCR results were missing, we were

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Table 2. Sociodemographic and heroin use variables and their univariate associations with HCV status

Variable	Total sample		HCV positive		HCV negative		OR	95% CI	p value
	n	%	n	%	n	%			
Female gender	160	21.9	102	23.9	58	19.1	1.33	0.93–1.91	0.12
Age at entry, n, mean ± SD	726	35.7±8.0	424	36.9±8.2	302	33.9±7.4	1.05	1.03–1.07	0.00
Swiss nationality	558	77.4	327	77.3	231	77.5	0.99	0.69–1.41	0.95
Entry year group 2009–2013	407	55.8	220	51.6	187	61.7	0.66	0.49–0.89	0.01
Highest education									
No/partly completed compulsory	56	7.8	33	7.8	23	7.7			
Compulsory education completed	264	36.6	169	39.9	95	31.9	1.25	0.70–2.25	0.46
Vocational education, apprenticeship, general education	373	51.7	209	49.3	164	55.0	0.90	0.51–1.58	0.71
Higher vocational education, university	25	3.5	10	2.4	15	5.0	0.47	0.18–1.24	0.13
Other	4	0.6	3	0.7	1	0.3	1.19	0.12–11.47	0.88
Having children	212	29.2	130	30.7	82	27.2	1.19	0.86–1.66	0.29
Marital status									
Unmarried	528	72.6	295	69.4	233	77.2			
Married	58	8.0	35	8.2	23	7.6	1.20	0.69–2.08	0.52
Separated, divorced, widowed	141	19.4	95	22.4	46	15.2	1.62	1.10–2.40	0.02
Housing 30 days before entry									
Stable	508	70.1	293	68.9	215	71.7			
Unstable	87	12.0	52	12.2	35	11.7	1.06	0.67–1.69	0.81
Institution	130	17.9	80	18.8	50	16.7	1.16	0.78–1.73	0.45
Main source of income 30 days before entry									
Employment	91	12.7	48	11.5	43	14.4			
Pension	163	22.7	101	24.1	62	20.8	1.45	0.86–2.44	0.16
Social welfare	398	55.5	228	54.4	170	57.0	1.20	0.76–1.90	0.44
Partner, family, friends	27	3.8	14	3.3	13	4.4	1.03	0.43–2.43	0.95
Drug dealing, illegal activities, prostitution	22	3.1	18	4.3	4	1.3	3.98	1.23–12.83	0.02
Other	16	2.2	10	2.4	6	2.0	1.49	0.53–4.18	0.45
Judicial decision as basis of HAT	45	6.3	30	7.2	15	5.0	1.46	0.77–2.76	0.24
Time spent in detention or prison	399	62.4	264	69.7	135	51.9	2.02	1.46–2.79	0.00
30 days point prevalence of illegal heroin use									
No use	131	18.2	80	19.1	51	16.9			
1–10 days	148	20.5	96	22.9	52	17.2	1.18	0.72–1.92	0.51
11–20 days	97	13.5	56	13.4	41	13.6	0.87	0.51–1.49	0.61
>20 days	345	47.9	187	44.6	158	52.3	0.76	0.50–1.14	0.18
Predominant form of heroin use									
Oral including smoke	47	7.0	13	3.3	34	11.9			
Nasal	87	12.9	44	11.3	43	15.0	2.44	1.13–5.26	0.02
Injected	234	34.6	150	38.5	84	29.4	4.11	2.06–8.19	0.00
Injected plus other form	269	39.8	170	43.6	99	34.6	3.93	1.96–7.86	0.00
Not injected but several other forms	39	5.8	13	3.3	26	9.1	1.35	0.56–3.29	0.51
Age at first heroin use, n, mean ± SD	706	19.0±5.0	414	18.7±4.8	292	19.5±5.2	0.97	0.94–1.00	0.04
Years of regular heroin use, n, mean ± SD	677	13.3±7.2	396	14.4±7.4	281	11.8±6.8	1.04	1.01–1.07	0.02
Years of intravenous use, n, mean ± SD	694	10.1±8.3	401	12.3±8.3	293	7.1±7.2	1.08	1.06–1.11	0.00

Table 3. Multivariate predictors of HCV status

	B	SE	p	OR	95% CI
Age at entry	0.05	0.01	0.00	1.05	1.02–1.08
Female gender	0.62	0.22	0.01	1.85	1.21–2.83
Entering after 2008	–0.45	0.17	0.01	0.64	0.46–0.89
Having spent 1 month or more in detention or prison	0.68	0.19	0.00	1.97	1.36–2.83
Form of heroin use					
Oral including smoking (ref.)					
Nasal	0.61	0.42	0.15	1.85	0.81–4.20
Injected	1.17	0.39	0.00	3.24	1.50–6.70
Injected plus other form	1.23	0.39	0.00	3.42	1.60–7.27
Not injected but several other forms	0.11	0.49	0.83	1.12	0.42–2.94
Years of intravenous use	0.04	0.01	0.00	1.04	1.02–1.07
Age at first heroin use	–0.04	0.02	0.03	0.96	0.92–1.00
Constant	–2.23	0.57	0.00	0.11	0.04–0.33

unable to classify more clients as 'HCV chronic'. We suspect that missing data can be partly explained by insufficient knowledge about adequate HCV testing among health care providers.

According to our results, clients of HAT with more years of intravenous drug use were more likely to be HCV positive than clients with a shorter experience of intravenous use. This finding is in line with numerous other findings [8–11]. It illustrates that longer drug use implies more cumulative risk exposure. As with the duration of intravenous use, greater age at entry and lower age at first heroin use predicted HCV-positive status. Both of these variables are likely to coincide with longer drug intake.

Use of injected rather than oral heroin was linked to an increase in the risk of being HCV-positive by up to 3.4-fold. Although oral (and nasal) drug use has also been associated with a substantial risk of HCV [24], in our sample, only 3% of clients with oral use (or 12% for nasal use) were HCV-positive, compared to ca. 40% in clients with intravenous use. Thus, in our sample of HAT clients, intravenous use implied a clearly higher risk of HCV exposure. The importance of targeting users before they start intravenous use, a period that may last up to 2 years, has been emphasised. During this period, efforts should aim at preventing intravenous use, by raising users' awareness of the advantages of non-parenteral routes of administration [10]. Frequency of heroin use, however, did not affect the HCV status. In fact, descriptive data showed that HCV risk decreased as the frequency of days of using heroin prior to HAT entry increased. This is at first sight a curious finding, but it has also been found in another study [25]. We suggest that individuals with higher frequency of use are more likely to experience complications that lead them to medical centres where they are also confronted with HCV prevention.

Individuals who entered HAT in the period from 2005 to 2008 were more likely to be HCV-positive than individuals who entered more recently. This might be due to the positive effect of the Swiss-wide HCV campaign implemented in 2008 [16].

Entering HAT on the basis of a judicial decision was not associated with HCV status. In contrast, having spent time in prison predicted HCV status. This is in line with numerous earlier findings [9, 11, 25]. In Switzerland, the precise extent of drug use in prisons is unknown and political neglect of this problem has been criticised. Up to one quarter of prisoners are drug dependent and it is suspected that drugs are regularly smuggled or sent to prisoners [26]. To prevent transmission of HCV in prisons, needle and syringe exchange or substitution programs in all prisons should be considered [25]. Aside from infection with HCV during imprisonment, for some individuals, the time in prison may be the end point of a history of marginalisation, involving not only criminal activity, but also unemployment, difficulties in finding accommodation or similar conditions that are associated with risk behaviours, reduced access to prevention and medical care, and therefore higher HCV risk [11]. Living in unstable housing or having illegal activities or prostitution as the main source of income could be considered other indicators of marginalisation, but these factors do not predict the HCV status. This could be because the time window of these assessments (30 days prior to entry) was not representative enough of clients' long-term situation.

Finally, according to our findings, female HAT clients had a higher risk of being HCV-positive than male clients.

This finding is consistent with previous studies [12, 13]. One explanation might be that females are biologically more susceptible to contract HCV [12]. Furthermore, behavioural differences could play a role. For instance, women were more likely to have ever sold sex than men [27]. Other studies found that women were more likely to engage in equipment sharing than men, and that women tended to be receptive in sharing syringes more often than men [28]. Similarly, it could be assumed that women tend to have older sexual or injecting partners with longer drug careers and thus with a higher risk of HCV, thereby enhancing women's risk of infection. In addition, female substance abusers were more likely to have a history of overdose, psychiatric illness, and alcohol intake above the national recommended guidelines, all of which might facilitate high-risk behaviour [29]. Our analysis is unaffected by the finding that women are more likely to clear HCV than men [30] because in our dependent variable, we summarised individuals with current or past infection.

Nationality was not significantly associated with HCV risk in multivariate analysis. This finding disagrees with other findings regarding different ethnicities [9, 11]. It suggests that in Switzerland, foreign nationality is not a factor in explaining differences in drug users' HCV risk exposure or access to prevention. Marital status or having children did not predict HCV status either. This contrasts with another study that identified 'being divorced' and 'parenthood' as risk factors of HCV, which has been explained by the fact that divorced individuals and those who have children are usually older, and older age is a risk factor in itself [8].

One limitation of our study is that we were not able to directly supervise the process of information collection. This has potential implications for data quality, particularly in the case of the relatively complex assessment of hepatitis status. Our data were collected by the institutions and then passed on to us. For laboratory results taken at entry into HAT, we must trust that blood tests were conducted using scientifically appropriate methods and that results were correctly reported to and by the caregiver filling in the questionnaire. Older test results would either rely on clients' self-reports, which might be susceptible to recall bias, or caregivers' investigations with relevant information sources. Thus, the results may be imprecise, particularly the older results.

Furthermore, even though sharing equipment is considered to be the most evident route of infection transmission in IDUs, our multivariate analysis is missing this potentially important predictor. The format used to assess this variable in our questionnaire would have substantially reduced the number of cases for the logistic regression analysis, as only those with intravenous use in the previous 6 months were asked about sharing equipment. Despite strong evidence for equipment sharing as a factor of HCV, other studies have failed to show such an association in multivariate analyses [9, 10]. This could be because the assessment missed equipment other than needles or syringes or because of methodological bias, such as referring the assessment of equipment sharing to a short time window [9].

Another limitation concerns the differing number of completed questionnaires per year. In 2007, only 70% of questionnaires were completed. Thus, for 2007, data are less representative than for other years and the absolute prevalence of hepatitis and HIV for that year should be interpreted more cautiously. Nevertheless, over a period of 10 years, we observed clear developments in the prevalence of hepatitis and HIV that match the findings of Gerlich et al. [5] for the years before our study. These observations indicate the validity of our data. An associated limitation is that some treatment centres provided more data than others. The institution with the lowest rate of completed questionnaires (54%) was very small, with only 13 new entries in 10 years. Therefore, a potential selection bias in this institution carries little weight in our analysis. The institutions with the next lowest completion rates provided 67% (n = 73) and 76% (n = 31) of questionnaires. Thus, across treatment centres there was little variation in completion rates.

Clients with a lower rate of heroin use and those who injected heroin were more likely to provide data on hepatitis and HIV status. While we cannot exclude a small bias towards less severe users and those using heroin intravenously in our results on prevalence, this problem does not extend to multivariate analysis, in which both variables were accounted for as predictors.

Conclusion

Our study presents recent data on hepatitis and HIV infection rates in HAT clients, a severely affected subgroup of heroin users. Further, we report developments in hepatitis and HIV infection in these clients since 2003. We observed decreasing prevalence rates of HAV, HBV and HCV and simultaneous increases in vaccination rates against HAV and HBV in our sample of severely addicted heroin users. These developments are highly encouraging and reinforce further investment into preventive programs, such as the national hepatitis campaign, which

started in 2008 and is still ongoing. Hepatitis prevalence in HAT clients still lies at a higher level than in the general population. Thus, efforts in the prevention and vaccination of heroin users should continue. HIV rates have remained stable during the observation period. As around 10% of HAT clients were still HIV-positive in 2013, further HIV prevention should take place in this population.

Our predictor analysis showed that the focus of HCV prevention should be centered around two areas: first on the period before heroin users actually start injecting themselves with the drug and second on female heroin users. Furthermore, our results support political efforts to implement needle and syringe exchange programs in prisons.

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